

REPORT OF THE COMMITTEE OF VISITORS

**Climate and Environmental Sciences Division
Office of Biological and Environmental Research
Office of Science
US Department of Energy**

*Findings and Recommendations from a
Review of Fiscal Years 2013-2015*

Charge to the Committee



Department of Energy
Office of Science
Washington, DC 20585

Office of the

NOV 03 2015

Dr. Gary Stacey
Associate Director, National Soybean Biotechnology Center
Department of Microbiology and Molecular Immunology
271E Christopher S. Bond Life Sciences Center
University of Missouri
Columbia, MO 65211

Dear Dr. Stacey:

By this letter, I am charging the Biological and Environmental Research Advisory Committee (BERAC) to assemble a Committee of Visitors (COV) to assess the processes used by the Climate and Environmental Sciences Division (CESD) within the Office of Biological and Environmental Research (BER) to manage CESD research programs and its user facilities, the William R. Wiley Environmental Molecular Sciences Laboratory (EMSL) and the Atmospheric Radiation Measurement (ARM) Climate Research Facility (ARM).

The COV should assess the operations of the CESD's programs for fiscal years 2013, 2014, and 2015. This includes funding at national laboratories and universities and other activities handled by the program during this time period. It should also assess the quality of the resulting scientific portfolio, including its breadth and depth and its national and international standing. Additionally, the COV should also assess the division's management and oversight of the ARM and EMSL user facilities for the same time period. Specifically, I would like the panel to consider and provide an evaluation of the following:

1. For both the DOE national laboratory projects and university grants, assess the efficacy and quality of the processes used by CESD programs during the past three years to:
 - a) solicit, review, recommend and document application and proposal actions, and
 - b) monitor active awards, projects and programs.
2. Within the boundaries defined by DOE mission and available funding, comment on how the award process has affected:
 - a) the breadth and depth of the portfolio elements, and
 - b) the national and international standing of the portfolio elements.

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COV members will be given access to all program documentation completed during the period under review including applications, proposals, review documents and other requests. COV members may also request, at their discretion, a representative sample of the program portfolio be provided. In response, CESD may suggest a sample of actions, including new, renewal and supplemental applications and proposals, awards, and declinations. In addition, COV members may also choose to review files through a random selection process. The guidance for all COV reviews within the Office of Science can be found at <http://science.energy.gov/sc-2/committees-of-visitors/> and attachments therein.

The COV should take place in the third quarter of FY2016 (Summer 2016) at the BER/DOE Germantown location at 19901 Germantown Road, Germantown, Maryland 20874-1290. A discussion of the COV report by BERAC should be held no later than the Fall 2016 BERAC meeting. Following acceptance of the full BERAC membership, the COV report with findings and recommendations is to be presented to me, as the Acting Director, Office of Science.

If you have any questions regarding this charge, please contact Gary Geernaert, 301-903-3281 or by email Gerald.Geernaert@science.doe.gov.

Sincerely,

Patricia Dehmer
Acting Director, Office of Science

cc: Sharlene Weatherwax
Gary Geernaert



Programs and Facilities Reviewed

- Earth System Modeling
- Regional and Global Climate Modeling
- Integrated Assessment
- Terrestrial Ecosystem Science/Carbon Dioxide Information Analysis Center
- Subsurface Biogeochemical Research
- Atmospheric System Research
- ARM Climate Research Facility
- Environmental Molecular Sciences Laboratory
- Data and Computing

Cross Cutting Themes

User Facilities and Community Infrastructure

Interagency Coordination

Workshops and Initiatives

SFA Management and Alignment with CESD Strategic Plan

COV Members

Jeffrey Arnold

Senior Scientist, US Army Corps of Engineers

Joseph Berry

Acting Director, Dept. Global Ecology, Carnegie
Institution for Science

James (Jae) Edmonds

Chief Scientist, Pacific Northwest National Laboratory
Joint Global Change Research Institute at the U.
Maryland, and College Park Professor of Public Policy
U. Maryland

Rong Fu

Professor, Dept Atmospheric & Oceanic Sciences, UCLA

Stuart Grandy

Associate Professor of Soil Biogeochemistry & Fertility,
University of New Hampshire

Roy Haggerty

Professor, Dept Geosciences, Oregon State University

Heileen (Helen) Hsu-Kim

Associate Professor, Civil & Environmental Engineering
Dept., Duke University

Kerstin Kleese van Dam

Director, Computational Science Initiative, Brookhaven
National Laboratory

Tsengdar Lee

Scientific Computing Portfolio Manager, Weather Focus
Area Lead, Program Scientist NASA Science Mission
Directorate

Norman Loeb

Physical Scientist, NASA Langley Research Center

Sandy Lucas

Program Manager, Climate Variability & Predictability
Program NOAA Climate Program Office

Gerald A. Meehl

Senior Scientist, National Center for Atmospheric
Research

Robert Pincus

Senior Research Scientist, Cooperative Institute for
Research in Environmental Sciences, U. Colorado

David Randall (Chair)

Professor, Dept Atmospheric Science, Colorado State U.

Albert Semtner, Jr.

Professor Emeritus, Naval Postgraduate School

Neil Sturchio

Professor and Chair, Dept Geological Sciences, U.
Delaware

Michael Wehner

Senior Staff Scientist, Lawrence Berkeley National
Laboratory

Minghua Zhang

Dean and Director, School of Marine and Atmospheric
Sciences, Stony Brook University

COV Operations: Materials Examined

Funding Opportunity Announcements

Merit Review Guidance

Preproposals and preproposal decisions

Reviewer and panel compositions

Proposals

Reviews

Summary Presentations by Program Managers

Presentations on Cross Cutting Themes

Justifications of award or declinations

Communications with PIs

Progress reports and information about how they are used

Information about monitoring methods

Information about workshops and meetings

Evidence of portfolio quality

Responses to the previous COV report

COV Operations: Site Visit

July 19-21, Germantown

Overview presentations by Gary Geernaert

Summary presentations by Program Managers

Presentations on cross-cutting themes

Discussions with Program Managers

Questions and answers

Discussions among COV members

Presentation of preliminary findings & recommendations

Recommendations from the previous COV, and actions taken

| Recommendation | Actions during FY13-15 |
|--|--|
| Maintain flexibility with SFAs to allow exploratory research; reduce administrative burden, especially for teams with prior “excellent” reviews. | Greater dialog with SFA teams prior to reviews, to assure alignment. Has led to more rapid BER approval process for most. |
| Maintain into the future the current balance of lab and university research. | We have strived to maintain this balance through the period for the science programs. |
| Increase travel funds for PMs to attend scientific meetings. | Travel budgets for BER staff have increased during the FY13-15 period. |
| Improve DOE electronic grant information system. | The PAMS system became operational and has reduced the amount of “hard copy” paperwork. |
| Develop program-wide metrics of performance and progress. | ACME in particular prompted a process to assure that Labs reward staff using other metrics than just publications. |
| PMs to engage the scientific community to assure protection of legacy data and acquiring new instruments. | Numerous workshops on data management, cyberinfrastructure, and the future of facility capabilities were conducted during the period. |
| Maintain proactive collaborations with university community and investments in CESM. | BER created a CESM branch model that links to the exascale strategy, and we expect ACME to be a major model once released. We continue to invest in CESM. |
| The MIT IA project should be based on a more sustained funding instrument. | The MIT project was converted to a Cooperative Agreement. So also were the NPS and Stanford projects. |
| Strengthen collaboration with other agencies on carbon cycle and modeling. | Joint FOAs were issued with NASA and NSF during the period, and aggressive efforts were placed on using the MODEX paradigm. |
| Maintain SBR expertise in radionuclide research at the Labs and Universities. | BER is committed to sustained expertise, yet with more dual-use value to carbon and hydrobiogeochemistry that is of increasing importance to climate and environmental modeling. |
| ARM to continue development of “best estimate” data sets. | Agreed. This has happened. |
| ARM needs better documentation of scientific input that support SISC and IMB decisions. | ARM has done well to improve documentation. |
| Proposals to ARM should have summaries of previous activities to improve process. | ARM has required summaries of its new proposals. |
| EMSL should strive to increase its user pool, especially to attract new users. | EMSL has dedicated considerable attention to increasing users, particularly on topics that are aligned with BER. |

Acknowledgements

Special thanks go to David Lesmes for his work in organizing the mechanics of the review.

Sharlene Weatherwax, Director of DOE's Biological and Environmental Research Program, supported our efforts. Gary Geernaert, Director of CESD, presented valuable introductory overviews.

Program Managers Paul Bayer, Jared DeForest, Roland Hirsch, Jay Hnilo, Renu Joseph, Dorothy Koch, Mike Kuperberg, David Lesmes, Sally McFarlane, Shaima Nasiri, Rickey Petty, Daniel Stover, Bob Vallario, and Ashley Williamson provided the information we needed to carry out the review. We appreciate the effort that they put into their superb presentations, and their willingness to answer a wide range of questions.

Excellent administrative support was provided by Nver Mekerdjian, Leslie Runion and Andrew Flatness of DOE, and Tracey Vieser of ORISE.

A Preliminary Comment

The COV was pleased to receive much of its input electronically. CESD should aim to provide *all* input to the next COV in electronic form, so that there will be no need for the next COV to dig through boxes of paper files.

The COV appreciates that some sensitive information, such as the identities of reviewers, should only be accessible to the COV while at the DOE Headquarters. An effort should be made, however, to ensure that all non-sensitive information is provided to the next COV electronically in a form that can be accessed away from DOE Headquarters. This will make the work of the next COV more efficient and convenient.

General Findings

General Finding #1

The COV commends CESD for great job of incorporating the visions of DOE and USGCRP and coordinating with other federal agencies in developing its own vision and priorities.

General Finding #2

The program solicitations have been consistent with the priorities of CESD. Review panels have been of high quality with expertise relevant to the program in general and to the particular solicitations. CESD is supporting a useful mix of large and small projects, university and lab projects, proposal-driven funding and SFAs. Only top-ranked proposals have been funded, with a few exceptions to maintain program balance. The review process and funding decisions have been well documented. The management of Scientific Focus Areas has been rigorous, and the CESD Program Managers are commended for their diligence. Overall, the COV finds that the funding decision process is appropriate and leads to outcomes that are consistent with the language given in the FOAs.

General Finding #3

CESD has played an unparalleled role in providing observations for advancing the understanding of climate processes, both nationally and internationally. In particular, the current budget of the Atmospheric Radiation Measurement Climate Research Facility is about \$68 M per year, and the total amount expended since effort's inception in 1989 is close to one billion dollars. ARM is the largest field program in the history of atmospheric science.

General Finding #4

The travel budget continues to limit the ability of Program Managers to attend meetings and to interact with the larger scientific community. This makes project management much harder. A similar comment and associated recommendation were also put forward in the previous review. The issue has not yet been adequately addressed.

General Recommendations

General Recommendation #1

CESD could benefit greatly from the external perspectives of experts from the broader scientific community to strengthen its strategic planning. The COV recommends that CESD ask the National Academy of Sciences to create a study group for this purpose. The study group would be analogous to the Decadal Survey commissioned by NASA, NOAA and USGS that provides guidance to NASA's programmatic decisions in space and earth science. Because of the size of CESD's climate program, the work of the study group would benefit not only CESD but the entire U.S. climate research program.

General Recommendation #2

Program Managers should work to provide more detailed, constructive feedback to unsuccessful proposers. In particular, communication of the reasons for rejections of proposals should be more clearly stated to the applicant so that he or she can determine which aspects of the proposed project reviewed well or poorly. This is particularly important for proposals that reviewed well but were not funded.

General Recommendation #3

The COV recommends that CESD formulate a more formal and transparent process for initiating/terminating SFAs and other large projects. Consistency is needed in terms of review frequency, review process, and reporting format, for all SFAs and comparable large projects.

General Recommendation #4

The COV finds that the balance of funding between DOE labs and universities in most CESD programs is largely appropriate, although the reduction of funding to universities in the SBR program is noted with some concern. The COV considers CESD's investments in university research to be critical for the missions of all its programs, and also for the training of graduate students who will enter the lab workforce. It is therefore recommended that CESD programs should increase funding in support of university research.

General Recommendation #5

The individual DOE Program Managers should have travel budgets and management support to attend and participate in person in key national and international meetings, and also to make site visits to their funded constituents and field observation sites. Program manager visits to constituents would result in a net cost saving to DOE because it would reduce the need for “reverse site visits” in which large groups of constituents travel to the Washington DC area. This issue has been raised in previous reviews. It is time to resolve it.

Program Recommendations

Recommendation to the Atmospheric Radiation Measurements Facility

In view of many recent developments, the ARM Climate Research Facility should be externally reviewed again within the next few years. This will supplement the internal review carried out during 2014. The scope of the recommended external review should include the relationship between ARM and ASR.

Recommendation to Atmospheric System Research

The relationships between ASR, ARM, RGCM and ESM should be clarified both within CESD and to the external community. ASR, perhaps in conjunction with RGCM and/or ESM, should support some high-quality climate research that involves clouds and radiation and supports ASR goals but *does not* make use of ARM data.

Recommendation to Earth System Modeling

The primary focus of the ACME effort should remain a 25-km atmosphere (or higher) coupled to a high resolution version of MPAS-O, consistent with ACME securing a unique niche in the climate modeling community by targeting a very high resolution earth system model to run on exascale machines. The 100-km atmosphere of ACME should be used for efficient testing in support of developing the very high resolution version, and its applications should be aimed at those related efforts within DOE, such as those in biogeochemistry.

Recommendation to Regional and Global Climate Modeling

The nature of many CESD activities, e.g., model development, requires performance metrics beyond traditional measures like publication and impact factors. The COV recommends a clear articulation of these alternate metrics and rigorous evaluation against them. This recommendation is also relevant to other CESD programs.

Recommendation to Integrated Assessment

The specific pages of the DOE CESD website for IAR could usefully be updated to provide information somewhat more like that included on the pages for the CESD RGCM section. The COV recognizes the many differences between IAR and RGCM which could restrict some information in possible future pages built for IAR, but think that more information where allowable through that source would be helpful to the program and its participants in DOE labs and the wider academic community.

Climate and Environmental Sciences Division (CESD)

Regional & Global Climate Modeling (RGCM) Program

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Program Mission and Description

The goal of the RGCM program is to advance the predictive understanding of Earth's climate by focusing on scientific analysis of the dominant sets of governing processes that describe climate change on regional scales; evaluating robust methods to obtain higher spatial resolution for projections of climate and earth system change; and diagnosing model systems that are cause for uncertainty in regional climate projections. The program goal is accomplished through sensitivity studies and applications of regional and global earth system models that focus on various aspects of the climate system, including but not limited to, the understanding of feedbacks within the climate system, detection and attribution studies, developing capabilities for decadal predictability, and uncertainty characterization. RGCM investments are also dedicated to development of metrics for model validation, that in turn may be used to inform the model development strategies of [Earth System Modeling \(ESM\)](#), and to inform the process research priorities of the [Terrestrial Ecosystem Sciences \(TES\)](#) and the [Atmospheric Systems Research \(ASR\)](#) programs. RGCM also coordinates with the [Integrated Assessment Research \(IAR\)](#) program on understanding individual and select coupled systems, such as water resources, critical for the energy mission.

Current descriptions of the RGCM and other Climate and Earth System Modeling projects, publications and other news can be found here: <http://www.climatemodeling.science.energy.gov/>

RGCM Priorities:

1. Development of robust analytical frameworks and model hierarchies to advance Earth system projections, predictions, and hindcasts, and to understand climate evolution at multiple scales. This priority also includes decadal predictions for specific regions, using high-resolution and variable scale climate modeling, and applying a combination of dynamical and statistical downscaling methodologies. Metrics are developed and assessed depending on measurement availability and quality, and depending on temporal and spatial scales.
2. Focused investigation of regions that are climatically sensitive or vital to climate assessments.
 - **Arctic focus:** Analyze the complex interactions between sea ice, ice sheets, cold oceans, regional climate, and

Recommendation to Terrestrial Ecosystem Science/Carbon Dioxide Information Analysis Center

The TES portfolio has an explicit bias toward non-managed ecosystems. This is understandable, but managed ecosystems are a significant component of the Earth System, and it is difficult to see how the predictive capacity of Earth System models can be tested without accurate representation of managed ecosystems. The COV recommends that CESD develop a strategy to deal with this gap, perhaps through cooperation with agencies that do support modeling of managed ecosystems.

Recommendation to Subsurface Biogeochemical Research

Research in subsurface radionuclide transport should not be abandoned entirely because it is still needed to better manage legacy nuclear waste and to maintain national expertise in this area, which largely resides in the national laboratories. Further integration with the elements of the Terrestrial Ecosystem Science program is encouraged where feasible. Increased collaboration with university investigators is recommended to facilitate training the next generations of scientists.

Recommendation to Environmental Molecular Sciences Laboratory

EMSL is a facility that supports a broad experimental and computational community. Unfortunately, the current computing strategy is too limited in its focus on computational models developed by EMSL, such as NWChem and Subsurface. It is necessary to reach out beyond EMSL and support a wider base of BER computational users and models to justify the investment in EMSL's computing capabilities. Furthermore, EMSL should offer significant support to its experimental facilities users, including support for their experiment preparation, data analysis and management needs. The COV recommends an in-depth review and adjustment of the EMSL computing strategy to bring it in line with other national and international experimental user facilities.

Recommendation to Data and Computing

The COV is concerned that the revised Earth System Grid Federation will not adequately serve either the high resolution components of CMIP6 or the ACME modeling program due to funding constraints and certain dated infrastructural aspects of the system. Investments are needed to address these immediate DOE programmatic requirements. A close collaboration with DOE ASCR facilities (the Leadership Class Facilities and the Earth Sciences Network) and research (including the Scalable Data Management, Analysis, and Visualization Institute) will be essential to make this effort successful.

Recommendation #1 on Cross-Cutting Themes

We commend CESD for seeking community input to inform the evolution of their program. The RGCM program in particular has excellent connections with the broader community, but we are concerned that this is not true across the board. In particular, we find that participation in CESD workshops is overly weighted towards the existing CESD science community. The COV recommends that CESD broaden participation in CESD workshops.

Recommendation #2 on Cross-Cutting Themes

The COV recommends that Program Managers be more consistent in providing detailed, constructive feedback to proposers. Program Managers should consider peer-review of decision letters, and asking review panel members to write or contribute to the summaries.

The committee also recommends that Program Managers routinely provide information as to whether the proposal was declined for lack of technical merit or for programmatic balance.

Concluding Remarks

- CESD's programs are scientifically strong and well managed.
- The funding processes are of high quality, and the awards are monitored effectively.
- CESD's Program Managers are diligent and effective.
- The COV has made recommendations on many subjects, including external reviews, feedback to proposers, creation and termination of large projects, program balance, ACME focus, the relationship between ARM and ASR, performance metrics, enhancement of the Earth System Grid Federation, and program manager travel support.